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(54) **Optical readers.**

(57) To read optically encoded information over a wide range of densities, the present invention provides a spacer system on the tip of an optical reader. The optical reader may be a contact wand type device, for example including a fixed laser emitter. Alternatively, the optical reader may be a moving spot scanner. In either case, the emitter element of the optical reader produces a diverging beam of light. During a reading operation, the spacer contacts the object surface on which optically encoded indicia is formed. The spacer selectively defines at least two different distances between the light emitter, or the focal point of the emitted beam of light, and the object surface. Because of the beam divergence, the diameter of the beam at its point of impact on the object surface will be different for each of the two different distances. The different beam diameters provide the optical reader with different effective sensing spots for reading different density symbols. The present invention also incorporates an optical reader, typically a moving spot laser scanner, into a number of different types of computer data input devices, such as the stylus of a digitizer table and a computer "mouse." In one such integrated terminal embodiment, the optical reader is combined with a touch sensitive display and data input device.

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Technical Field

The instant invention relates to devices for reading optically encoded information of varying densities, for example bar codes, and to associated data input devices.

Background Art

Optically encoded information, such as bar codes, have become quite common. A bar code symbol consists of a series of light and dark regions, typically in the form of rectangles. The widths of the dark regions, the bars, and/or the widths of the light spaces between the bars indicates the encoded information. A specified number and arrangement of these elements represents a character. Standardized encoding schemes specify the arrangements for each character, the acceptable widths and spacings of the elements the number of characters a symbol may contain or whether symbol length is variable, etc.

To decode a bar code symbol and extract a legitimate message, a bar code reader scans the symbol to produce an analog electrical signal representative of the scanned symbol. A variety of scanning devices are known. The scanner could be a wand type reader including an emitter and a detector fixedly mounted in the wand, in which case the user manually moves the wand across the symbol. As the wand passes over the bar code, the emitter and associated optics produce a light spot which impacts on the code, and the detector senses the light reflected back from the light spot passing over each symbol of the code. Alternatively, an optical moving spot scanner scans a light beam, such as a laser beam, across the symbol; and a detector senses reflected light from the beam spot scanned across the symbol. In each case, the detector produces the analog scan signal representing the encoded information.

A digitizer processes the analog signal to produce a pulse signal where the widths and spacings between the pulses correspond to the widths of the bars and the spacings between the bars. The pulse signal from the digitizer is applied to a decoder which first determines the pulse widths and spacings of the signal from the digitizer. The decoder then analyzes the widths and spacings to find and decode a legitimate bar code message. This includes analysis to recognize legitimate characters and sequences, as defined by the appropriate code standard.

Different bar codes have different information densities and contain a different number of elements in a given area representing different amounts of encoded data. The denser the code, the smaller the elements and spacings. Printing of the small size denser symbols on an appropriate medium is exacting and thus is more expensive than printing large size low resolution symbols.

A bar code reader typically will have a specified resolution, often expressed by the size of its effective sensing spot. The resolution of the reader is established by parameters of the emitter or the detector, by lenses or apertures associated with either the emitter or the detector, by the threshold level of the digitizer, by programming in the decoder, or by a combination of two or more of these elements.

In a laser beam scanner, the effective sensing spot may correspond to the size of the beam at the point it impinges on the bar code. In a wand using an LED or the like, the spot size can be the illuminated area, or the spot size can be that portion of the illuminated area from which the detector effectively senses light reflections. By whatever means the spot size is set for a particular reader, the photodetector will effectively average the light detected over the area of the sensing spot. In one prior art example, U.S. Patent No. 4,675,531 to Clark et al., an LED illuminates the bar code and images the code onto a photodetector. The aperture of the photodetector determines the resolution or "spot size." In the Clarke et al. system the photodetector effectively averages the light detected over the area of the aperture.

A high resolution reader has a small spot size and can decode high density symbols. The high resolution reader, however, may have trouble accurately reading low density symbols because of the lower quality printing used for such symbols. This is particularly true of symbols printed by a dot matrix type printer. The high resolution reader may actually sense dot widths within a bar as individual bar elements. In contrast, a low resolution reader detects an average intensity using a large spot size and can decode low density noisy symbols. However, a reader for relatively noisy symbols of low density, such as the dot matrix symbols, senses and averages such a wide spot that two or more fine bars of a high resolution symbol may be within the spot at the same time. Consequently, a reader having a low resolution, compatible with dot matrix symbols, can not accurately read high density symbols. Thus any reader having a fixed resolution will be capable of reading bar codes only within a limited range of corresponding symbol densities.

Commonly assigned U.S. Patent Application Serial No. 07/735,573 filed July 25, 1991, to Barkan et al., discloses a wand or scanner system for reading optically encoded information having a wide range of densities. The system includes either optical or electronic means to derive two or more channels of data from each scan pass of the wand or scanning beam over a bar code. Each channel

of data has a different resolution, and the proposed system analyzes data from the two channels to obtain a valid result over a wide range of information densities. The optical and/or electronic solutions proposed in that application, however, are complex. The resulting system becomes costly, and the wand or scanner becomes larger and heavier due to the added components. A large, heavy handheld unit causes fatigue and discomfort when a user must hold and operate the unit for protracted periods.

Clearly a need exists in the art for a bar code reader which can be readily adapted to reading of bar codes over a wide range of symbol densities without adding undue complexity.

Another problem relates specifically to contact wand type bar code readers. Typically, such wands include an LED for emitting light to illuminate the bar code and a lens for focusing the widely divergent light from the LED onto the bar code. In many such wands, the lens is part of the actual tip of the wand, and consequently, the front surface of the lens contacts the surface on which the bar code is formed during scanning of the code symbols. Repeated use of the wand causes wear and scratching of the front surface of the lens. Such damage degrades the optical properties of the lens and reduces performance of the wand. As a result, the lens must be periodically replaced. Physical replacement of the lens, however, is time consuming and costly.

Further problems arise from association of the optical reader with other devices connected to a common computer system. In actual use, the device for reading optically encoded information typically connects to some form of computer. Often a need exists for entry of other data, in addition to that scanned by the optical reader. For example, in an inventory system using bar code readers the operator scans an item and then enters the quantity of such items presently in stock. Consequently, in most systems using optical readers of the type discussed above, the system will include additional data entry devices coupled to the same computer. Separate data entry devices, however, are often inconvenient to carry along in conjunction with a portable optical reading device. Also, the use of multiple data input devices requires use of several of the option card slots of the computer and additional physical wiring connections. Furthermore, multiple input devices often create software problems directing the multiple data input streams to a single application program running on the computer.

To alleviate these problems, a number of optical readers incorporate a keyboard and an alphanumeric display to form an integrated data entry terminal. These integrated terminals have included both contact wand type bar code readers and pistol grip type moving spot scanners. The data entry capabilities of such integrated terminals, however, have been limited by the nature of the keyboard and display.

A number of other types of data entry devices are known, and in many applications provide more convenient or "user friendly" data entry operation than do keyboards and alphanumeric displays. For example, a mouse allows a computer operator to move a cursor to point at an option illustrated on a display screen. The operator then "clicks" a button on the mouse to select the particular option. The mouse can also provide graphics data input. U.S. Patent No. 4,906,843 to Jones et al. discloses a combination mouse and optical scanner, but the optical scanner scans characters or graphics data, not optically encoded information such as bar codes. The user manually scans characters by moving the mouse across the surface on which the characters appear.

A number of other keyboardless, data entry terminals have been proposed. U.S. Patent No. 4,972,496 to Sklarew, for example, discloses a terminal device having a flat transparent input screen for generating input information when an operator contacts the screen with a stylus. A display screen mounted below the input screen displays symbols and graphic information drawn by the stylus. The operator inputs information into the associated computer through pen strokes essentially as if writing on a tablet with a pen. U.S. Patent No. 4,916,441 to Gombrich discloses a handheld terminal including a non-contact point source type bar code reader and a touch sensitive display screen.

From the above discussion it should be clear that a need still exists to further develop various computer input devices integrated with means to scan optically encoded indicia which also provide convenient operation.

DISCLOSURE OF THE INVENTION

Objectives:

One objective of this invention is to provide a bar code reader which is more convenient and efficient to use when reading encoded information over a wide range of densities.

In contact wand type embodiments, it is a further object of the invention to eliminate contact of the optical elements of the wand with the surface scanned in order to eliminate wear and damage to the optical components.

Another objective of the present invention is to provide an integrated data entry terminal for optically reading encoded information and for convenient input of other forms of data.

More specifically, one objective is to combine a bar code reader with a display and touch sensitive type data entry terminal, particularly where the bar code reader is a moving spot scanner. Alternatively it is an objective to incorporate a bar code reader, for example, the moving spot scanner, into the stylus of a graphic data input device. In another alternative, the moving spot bar code scanner is incorporated into a mouse type computer data entry device.

Summary:

In its simplest form, the reader for all densities comprises a contact type wand including a laser light emitter and a photodetector. The wand housing may be cylindrical with a circular opening at one end. Light from the emitter passes through the opening, reflects off optically encoded information, passes back through the opening and is sensed by the photodetector.

The laser light emitter will normally have some established focusing parameter. As a result, the emitted light beam will diverge at points farther away from the beam focal point. The different diameter of the beam at different distances can be used to establish a different sensing spot size for the wand. The different sensing spot sizes can then be used to efficiently read optically encoded information of different densities. To conveniently space the laser emitter at different distances from the surface of the encoded information, the invention therefore provides a means for contacting a surface on which the optically encoded information is formed. These means, typically in the form of a spacer, selectively define at least two different distances between the focal point of the diverging beam of light and the optically encoded information. Thus, the diverging beam of light will have a specific diameter at its point of impact on the optically encoded information for each of the two distances set by the spacer means, and the specific diameters will be different for each of the two different distances.

In its simplest form, the spacer means includes of the wand tip itself which contacts the encoded information and defines a first distance. At the first distance, the impact point is relatively close to the focal point and to the laser light emitter, the beam has diverged relatively little, and the resulting sensing spot diameter is small. The small sensing spot is effective in reading small bar code symbols, i.e. information of relatively high density. To establish at least one other distance, the spacer means further includes a detachable spacer module. The detachable spacer module can be mounted on the tip of the wand in a manner concentric about the circular opening in the tip. The detachable spacer module also has a tip for contact with the encoded information through which a second circular opening is formed. When attached to the tip of the wand, the detachable spacer module contacts the surface on which the code is formed during scanning across the code. The attached spacer effectively lengthens the wand structure and specifically establishes a second longer distance. At the longer distance, the impact point is relatively far away from the beam focal point and from the laser light emitter. At the impact point, the beam has diverged further, producing a larger diameter sensing spot. The large sensing spot is effective in reading larger and noisier printed bar code symbols. These larger bar code symbols correspond to optically encoded information of relatively low density, such as bar codes produced by a dot matrix printer.

A clear sealing member may be placed at some point within the housing between the opening and the emitter and photodetector. The sealing member prevents dust and dirt from entering. The sealing member is not located at the tip of the wand. The tip of the wand which contacts the surface of the optically encoded information is just an open end of the cylinder. Consequently, there is no optical element at the tip which ever contacts the encoded information, and problems of damaging and replacing such an optical element are eliminated.

The means for contacting the surface can take a variety of forms. For example, these means may comprise a spacer adjustably mounted on the housing of the wand. To change the distance, the spacer position is adjusted. In one example, the spacer may slide on or telescope with respect to the cylindrical wand housing. When the spacer reaches a position appropriate for reading a particular density symbol, the operator secures the spacer at that point by tightening a set screw. Alternatively, the fore end portion of the wand housing and the rear portion of the spacer could have matching threads, in which case the operator turns the spacer to change the position thereof and the overall length of the combined wand and spacer structure.

The spacer means can also be adapted for use with other types of optical readers. For example, another disclosed embodiment provides a spacer mounted on a pistol grip type moving spot laser scanner. The spacer provides a desired long fixed spacing of the scanner from the code which is particularly useful for scanning dot matrix type low density codes.

The present invention also provides a number of different forms of integrated data input terminal and optical reader type devices. One integrated terminal device has a generally gun-shaped housing. The elongated body of the housing has a front

region which includes a flat display with touch sensitive data input capabilities. A moving spot scanner within the housing emits a beam of light through a window in an intermediate body region extending between the front and rear regions of the housing. The beam is transmitted along a path parallel to the upper surface of the touch sensitive display in the front region of the housing. On an upper surface of the rear region of the housing, the terminal includes a keyboard. This positioning of the keyboard allows an operator to activate keys without interfering with emission of the beam.

In another embodiment, the integrated terminal includes a substantially flat housing having a front surface and a rear surface. Indicia-detection means emit a light beam from the rear surface of the housing for direction toward indicia to be read, and receive light reflected from the indicia to produce electrical signals representative of the indicia. Typically, the indicia detection means comprise a moving spot laser scanner and a photodetector. This embodiment further includes a touch sensitive display disposed on the front surface of the housing.

In a further embodiment, the invention comprises a stylus for input of positional data to an electronic digitizer tablet which also incorporates elements of an optical reader. In its broadest form the stylus would include a light emitter, a photodetector and the necessary electronics for operation as a stylus, all contained with a stylus type housing. The stylus electronics would correspond to the type of tablet being used and can take a variety of forms. For example, the stylus could apply a voltage to the tablet to facilitate resistive detection of the contact point on the surface of the digitizer tablet. Alternatively, the stylus could form a light pen, or provide a capacitive contact, etc. In the illustrated embodiments, the light emitter would comprise a moving spot laser scanner module; but the emitter and photodetector could correspond to the elements of a contact wand type reader. The stylus can connect to the tablet and/or an associated computer via a cable, or the stylus can include a battery and a wireless transmitter to send information signals to the computer.

In another aspect, the present invention incorporates an optical scanner, for reading optically encoded indicia, into a mouse type data input device. This embodiment would include a mouse with relatively standard electronics. The housing of the mouse also contains a moving spot optical scanner module and associated photodetector. The scanner emits a beam of light from the bottom surface of the mouse housing, and the photodetector detects the variable intensity of the returning portion of the light reflected from any object scanned. The photodetector generates an electrical analog signal indicative of the detected variable light intensity. Typically, at least the digitizer for converting analog signals from the photodetector to a pulse signal would also be located within the housing of the mouse. In a first version, a user picks up the mouse and activates a third trigger switch on the top surface of the housing to activate the optical reader. A second version includes a contact switch mounted in the lower surface of the housing. The contact switch detects when the mouse is resting on a surface and controls the device to provide standard mouse type signals to the associated computer. When the operator lifts the mouse off the surface, however, the contact switch triggers operation of the optical reader.

Typically, the light beam emitted by the scanners of the present invention will be in the visible range of the spectrum, for example red light. Consequently, the beam scan across the code or indicia will be visible to the operator. Also, the decode logic can provide a "beep" signal as an audible output upon detection of a valid read result. The visible beam and the "beep" signal provide feedback to the operator as to the operation of the scanner.

Additional objects, advantages and novel features of the invention will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art upon examination of the following or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

Brief Description of Drawings

Figures 1A and 1B illustrate in cross section a first embodiment of the invention, in the form of a wand type reader, with an adjustable spacer set at two different positions to provide two different beam spot sizes.

Figures 2A and 2B illustrate in cross section a second embodiment of the invention, in the form of a wand type reader, with a second adjustable spacer design set at two different positions to provide two different beam spot sizes.

Figures 3A, 3B and 3C illustrate in cross section a third embodiment of the invention, in the form of a wand type reader using detachable second spacers of different lengths.

Figure 4 illustrates a further embodiment of the invention, in the form of a pistol grip type moving spot scanner, with a spacer.

Figure 5 illustrates a further embodiment of the invention, in the form of a pistol grip type moving spot scanner with a touch screen display and input device and a keyboard forming an integrated data

input terminal.

Figures 6A and 6B show another embodiment of an integrated data input terminal having a moving spot scanner and a touch screen display and input device.

Figure 7 illustrates in cross section an embodiment of the invention, in the form of an electronic stylus incorporating a moving spot optical scanner.

Figure 8 shows an alternate embodiment of the stylus incorporating a moving spot optical scanner.

Figure 9 shows an alternate embodiment of the integrated stylus and scanner, similar to that of Figure 8, but using a wireless communication link to the associated computer system.

Figures 10A is a cross sectional view and Figure 10B is a top plan view of an embodiment of the invention wherein the optical scanner is incorporated into a mouse type input device.

Figure 11 illustrates an alternate embodiment of the mouse type input device with the incorporate optical scanner.

Best Mode for Carrying out the Invention

As shown in Figures 1A and 1B, the bar code wand 1 of the first embodiment includes a cylindrical housing 11 which contains a light emitter, such as a visible light laser diode (VLD) 13. The VLD 13 emits light which passes through an optical element, such as lens 15. The lens 15 focuses the laser light to a point P. The focused light passes through a transparent member 17 which serves to seal the wand against dust and debris. The housing 11 also contains a light sensitive photodetector 19, located behind the transparent sealing member 17, for sensing light reflected back from information scanned using the wand.

Since the wand uses a focused laser beam, no aperture is needed to define the sensing spot. Instead, the sensing spot of the laser wand corresponds to the size of the area illuminated by the beam and the diameter or spot size of the beam itself at the point where the beam impacts on the surface being scanned. As illustrated by comparison of Figures 1A and 1B, as the emitted light passes beyond the focal point P, the light diverges. At points close to the focal point, the beam diameter will be small, whereas at points further beyond the focal point the beam diameter will be larger. Thus, for different distances from the focal point, the beam will produce different size sensing spots which will be effective for reading different sizes and densities of symbols of optically encoded information.

The wand also includes a spacer member 21. The inside diameter of the distal end of the spacer 21 is slightly larger than the outside diameter of the fore end portion of the housing 11. Thus the spacer 21 can be slideably mounted on the fore end portion of the housing 11. When the spacer is in a desired position for reading a particular density, an operator tightens set screw 25 to secure the spacer in position. The fore end of the spacer 21 tapers to a point through which is formed aperture 23. Light from the VLD emerges from the aperture 23.

In use, an operator holds the wand in one hand and places the tip of the wand against the surface S on which is formed the encoded information, e.g. the bar code. To scan the information, the operator moves the wand across the symbols while maintaining contact of the tip of the spacer 21 with the surface S. Because the light beam diverges, the beam spot size at the point where the light impacts on the information surface will be determined by the distance from the focal point.

Comparison of Figure 1A to Figure 1B demonstrates how repositioning of the spacer will produce different beam spot diameters on the surface of the information during scanning. In Figure 1A, the spacer is mounted relatively far forward on the fore end of the housing 11. When the tip of the spacer contacts the surface S, the distance between the focal point P and the surface S is relatively long, and the beam spot is large. The large beam spot would be appropriate for reading low density encoded information, such as dot matrix printed bar-codes. In contrast, in Figure 1B the operator has telescoped the spacer back on the housing. When the tip of the spacer contacts the surface S, the distance between the focal point P and the surface S is relatively short, and the beam spot is small. The small beam spot would be appropriate for reading high density encoded information, such as very small size bar code symbols.

The invention of Figures 1A and 1B allows an operator to adjust a single wand to read a range of symbol densities. To change from a setting for one density to a new setting for another density, the operator simply loosens set screw 25, moves the spacer to a new position, tightens the set screw 25 and scans the wand 1 across the optically encoded information. If scanning is unsuccessful, the operator can repeat this procedure at another setting until the scanning is successful.

The second embodiment of the invention, using a threaded spacer structure appears in Figures 2A and 2B. Here, the bar code wand 1' includes a housing 11' which contains a VLD 13'. The VLD 13' emits light which passes through the lens 15' and is focused to a point P'. The focused light passes through a transparent member 17' which serves to seal the wand against dust and debris. The housing 11' also contains a detector 19', located behind the transparent sealing member 17, for sensing light reflected back from information scanned using the

wand.

The wand also includes a spacer member 21'. The male threaded outer surface of the fore end portion of housing 11' engages the female threaded distal end of the spacer 21'. Thus, the spacer 21' can be screwed onto the fore end portion of the housing 11' until it reaches a desired position for reading a particular density. The fore end of the spacer 21' tapers to a point through which is formed aperture 23'. Light from the VLD and emerges from the aperture 23'.

Comparison of Figure 2A to Figure 2B demonstrates how repositioning of the spacer in the second embodiment will produce different beam spot diameters on the surface of the information during scanning. In Figure 2A, the spacer is threaded to a position relatively far forward on the fore end of the housing 11'. When the tip of the spacer contacts the surface S, the distance between the focal point P' and the surface S is relatively long, and the beam spot is large. In contrast, in Figure 2B the operator has turned the spacer 21' so that the threads position the spacer relatively far back on the housing 11'. When the tip of the spacer contacts the surface S, the distance between the focal point P' and the surface S is relatively short, and the beam spot is small.

The invention of Figures 2A and 2B allows an operator to adjust a single wand to read a range of symbol densities. To change from a setting for one density to a new setting for another density, the operator simply turns the spacer 21' until it reaches a new position, and scans the wand across encoded information. If scanning is unsuccessful, the operator can repeat this procedure at another spacer position until the scanning is successful.

In the third and perhaps the simplest preferred embodiment of the invention, shown in Figures 3A-3C, the laser wand 101 has a structure similar to that of the wand used in the earlier described embodiments. For example, the cylindrical wand housing contains a VLD, a lens, a photodetector and a transparent sealing member. In the third embodiment, however, the fore end of the housing is designed for direct contact with the surface S on which the bar code appears. The fore end of the housing tapers, as shown at 121, to a circular aperture 123. The VLD emits light which is focused by the lens and passes through the transparent member to emerge through opening 123. The light will reflect back off of the bar code or other optically encoded information on the surface S, and the photodetector will sense the reflected light.

When the tapered tip 121 of the wand 101 contacts the surface S, during scanning across a code, the distance between the focal point and the surface S is relatively short. Consequently, the beam spot is small, as shown in Figure 3A. The small beam spot would be appropriate for reading high density encoded information, such as very small size bar code symbols.

To increase the spot size, for example to read lower density bar codes, the operator inserts the fore end of the wand 101 into a spacer 221, as shown in Figure 3B. The inside diameter of the distal end of the spacer 221 is minimally larger than the outside diameter of the fore end portion of the wand 101. This produces a friction or pressure fit of the spacer 221 on the wand 101. The tension between the spacer and the wand should be sufficient to retain the spacer in place on the tip of the wand during scanning but still allow an operator to manually attach and remove the spacer from the wand.

The spacer 221 serves to lengthen the distance between the focal point and the surface S. With the spacer 221 mounted on the tip of wand 101, the operator contacts the fore end of the spacer to the surface S and scans the wand across the code. The increased distance between the focal point and the surface S causes the spot size of the beam at the point of impact on the surface to increase. Figure 3B shows that the beam at the point of impact will have a larger diameter than would be the case without the spacer, as shown in Figure 3A. The larger spot size of Figure 3B would be suitable for reading of medium density bar code symbols.

To further increase the spot size, to read extremely low density bar codes such as those printed by dot matrix printers, the operator inserts the fore end of the wand 101 into another spacer 321, as shown in Figure 3C. As with the spacer 221, the spacer 321 is designed to provide a friction or pressure fit of the spacer 321 onto the tip of wand 101. This serves to retain the spacer 321 in place on the tip of the wand 101 but still allows an operator to manually attach and remove the spacer 321 from the wand.

The spacer 321 includes a cylindrical extension on the tip thereof which makes the spacer 321 longer than the spacer 221. This extension can take virtually any shape the designer chooses so long as it increase the length of the spacer by a desired amount. Spacer 321 therefore provides a still longer distance between the focal point and the surface S than did the wand 101 alone (Figure 3A) or the wand with the spacer 221 attached (Figure 3B). Again, the increased distance between the focal point and the surface S serves to increase the spot size of the beam at the point where the diverging light beam impacts on the scanned surface S. Comparing Figures 3A-3C, it should be clear that the longer distance provided by spacer 321 produces the largest spot size. With the spacer 221 mounted on the tip of wand 101, the operator

contacts the fore end of the space to the surface S and scans the wand across the code, and during such scanning the larger spot size would adapt the wand to effectively read low density bar code symbols.

In use, an operator adds or changes spacers whenever a scan is unsuccessful, and then tries to scan the code again. This procedure can be repeated, as necessary until the operator finds the correct spacer and spot size for the current code.

Although shown as using two different length detachable spacers 221, 321, more spacers can be provided. For many applications, however, one spacer will be enough. The operator would use the wand without a spacer for small high density symbols and at least some mid-range density symbols. The operator would use the wand with a long spacer, such as spacer 321, for the large low density symbols and the remaining mid-range density symbols. A wire or chain or the like normally connects the spacer or spacers to the housing of the wand, to ensure that the spacers remain with the wand.

In the embodiments of Figures 1-3, each spacer or wand tip which contacts the surface comprises only a circular opening. There are not optical elements at the point of contact with the surface. This structure eliminates the problems of damaging an optical element by contact of the element with the surface and the resultant need for element replacement.

Although Figures 1-3 show the VLD and the lens as separately mounted elements, they could easily comprise elements of a combined laser and optics assembly. For example, the assembly might include an elongated hollow tube, a laser diode fixedly mounted at one end of the tube, and a lens barrel mounted at the opposite end of the tube. The lens barrel would contain a focusing lens, and if necessary, an aperture stop. Together, the lens and aperture would define the focal point and the beam diameter at various distances beyond the focal point. U.S. Patent No. 4,816,660 discloses one example of such an assembly.

In each of the above discussed embodiments, the shape of the spacers can vary greatly, to adapt to different bar code reader designs and/or specific information scanning applications. For example, it is possible to adapt the spacer for use on a moving spot type laser scanner, as shown in Figure 4. As illustrated, the scanner 401 is a pistol grip type moving spot laser scanner. Normally, the operator holds the scanner 401 in one hand, points the scanner at the code to be scanned and pulls the trigger 403. The scanner emits a beam of light which reciprocates back and forth across the code, and a photodetector within the scanner housing senses the light reflected back from the code.

To provide a desired long fixed spacing from the optically encoded indicia, particularly for scanning dot matrix type low density bar codes, the operator places a spacer 421 on the fore end of the scanner 401. The operator holds the assembly so that the spacer 421 contacts the surface S on which the code is formed. The spacer positions the scanner 401 back away from the code to increase the distance between the laser source and the code. This again serves to increase the size of the beam spot at the point of impact as the beam scans across the surface. When the operator activates trigger 403, the scanner 401 produces a moving laser beam with a large spot size and scans that beam across the dot matrix bar code.

The optical reader of the present invention can take many forms, and may be combined with other means to enter data other than the optically encoded data. Figure 5 shows an exemplary embodiment of the pistol grip type moving spot laser scanner 401. The scanner includes a generally gun-shaped housing having an elongated body portion including a front region 51, a rear region 53, and an intermediate body region 52. To detect optically encoded indicia, the housing contains a moving spot optical scanner and associated photodetector.

Commonly assigned application Serial No. 07/193,265 filed May 11, 1988, discloses a mirrorless optical scanner, and application Serial No. 07/699,417 filed on May 13, 1991 discloses incorporation of such a scanner in a modular scanner component system facilitating use of the scanner in a variety of different housing configurations. For the moving spot scanner embodiments, the present invention preferably uses a scanner similar to that disclosed in these two copending applications, as discussed below with regard to Figure 7. The disclosures of these two applications are incorporated herein by reference in their entirety.

The scanner transmits a light beam through the forward facing inclined window 60 formed in the intermediate body region 52. When the operator aims the scanner at the indicia, e.g. at the bar code, the beam passes along a light path toward the indicia, and the photodetector will receive light reflected from the indicia to produce electrical signals representative of the indicia.

A keyboard 55, disposed on the upper surface in the rear region 53 of the housing includes a number of individual keys 58. This positioning of keyboard 55 places it out of the path of the emitted beam and out of the path of the reflected light. An operator manually enters alphanumeric data and/or selects specific functions by activation of the keys 58 of the keyboard 55. Because of its location, when the operator activates the keys, the operator's fingers will not block or otherwise interfere

with the emitted light beam or the light reflected from the scanned symbols.

A display device 54 is located on the upper surface of the front region 51 of the housing for displaying a variety information. In this embodiment, the display is oriented so that the flat upper surface of the display 54 is parallel to the path of the emitted beam of light. The display 54 is a touch sensitive display and data input device. When certain information is displayed calling for a user input, the operator can select functions or input certain related data by simply touching the corresponding area of the display screen 54. The display and touch panel of device 54 may comprise the integrated liquid crystal display and optical touch panel disclosed in U.S. Patent No. 4,916,308 to Meadows.

The embodiment of Figures 6A and 6B, incorporates the moving spot scanner into a flat panel or tablet type unit with a touch sensitive display device similar to but somewhat larger than the touch sensitive display 54 used in the embodiment of Figure 5. The scanner is positioned within the flat panel unit so as to emit the beam through a window in the rear surface of the unit.

A switch within the panel, for example a mercury switch, is sensitive to the orientation of the device. When oriented for holding with the right hand (Figure 6B), the switch conditions the associated electronics to operate the panel as a display and touch sensitive data input device. In this mode, the touch panel allows the user to input function selections and/or data simply by touching a position on the display screen, as in Figure 6B. When oriented for holding with the left hand, as in Figure 6A, the switch conditions the associated electronics to operate the unit as an optical reader. In this mode, a touching of the display panel acts as a trigger to activate the moving spot scanner and read optically encoded information scanned by the emitted beam.

In still further embodiments, the present invention incorporates elements of an optical reader into the stylus of a tablet type data input device. As shown for example in Figure 7, the stylus arrangement 10 comprises a hand-held housing 12 containing a lightweight, high-speed, miniature scanning motor 20 similar to that described in U.S. Patent No. 4,496,831. The motor 20 repetitively drives an output shaft 22 in alternate circumferential directions over arc lengths less than 360° in each direction about an axis along which the shaft extends. U.S. Patent No. 4,496,831 provides structural, functional and operational details of the motor 20 and of the associated motor control circuitry 24.

A generally U-shaped support structure 26 is mounted at the end of the shaft 22 of motor 20, in the stylus 10 of Figure 7. U-shaped structure 26 supports a laser emitter and optics assembly 28. As the motor 20 repetitively drives output shaft 22 in alternate circumferential directions, the subassembly 28 and the support structure 26 jointly oscillate and turn with the shaft 22.

The subassembly 28 includes an elongated hollow tube 30, a laser diode 32 fixedly mounted at one axial end region of the tube 30, and a lens barrel 34 mounted at the opposite axial end region of the tube 30. The lens barrel contains a focusing lens (not shown); and the lens barrel may provide an aperture stop, if necessary, to define the beam diameter and thereby the effective sensing spot of the scanner. The focusing lens is preferably a plano-convex lens, but may be spherical, convex or cylindrical. U.S. Patent No. 4,816,660 describes the subassembly 28 in detail. The solid state laser diode 32, of the subassembly 28, generates an incident laser beam, either in the invisible or visible light range. The lens focuses the laser beam such that the beam cross-section or beam spot will have a certain waist size at distances within a working range relative to the housing 12. The focused beam passes through the window 40; and during the alternate, repetitive oscillations of the shaft 22, as the support 26 and the subassembly 28 concurrently oscillate, the beam spot is be swept in an arc across the encoded information or bar code symbol.

A portion of the light reflected off the symbol passes along a return path back through the window 40 to a photodetector 44. Photodetector 44 senses the variable intensity of the returning portion of the reflected laser light and generates an electrical analog signal indicative of the detected variable light intensity. In the illustrated embodiment, the photodetector 44 is stationarily mounted, but could be mounted on the support structure 26 for oscillation with the laser and optics subassembly 28.

In addition to the control circuitry 24 for controlling operation of motor 20, the printed circuit board 48 may contain signal processing circuitry and microprocessor control circuitry for converting the analog electrical signal to a pulse signal, and for analyzing the pulse signal widths and spacings to derive digital data for the encoded symbols scanned by the beam.

To scan encoded information using the stylus, the user points the tip of the stylus 10 at the information and activates a trigger button (not shown). The laser diode emits a beam which scans the encoded information, and the photodetector outputs an analog electrical signal representative of any scanned symbols. A digitizer processes the analog signal to produce a pulse signal where the widths and spacings between the pulses correspond to the widths of the bars and the spacings

between the bars; and the pulse signal from the digitizer is applied to a decoder. The decoder first determines the pulse widths and spacings of the signal from the digitizer. The decoder then analyzes the widths and spacings to find and decode a legitimate bar code message.

If the digitizer and decoder are elements of the circuitry or software included on board 48, then the decoded characters are transmitted to the associated computer. In the embodiment of Figure 7, a cable carries the digital data representing the decoded characters to the associated computer, e.g. via the connection to the display and resistive stylus input tablet. Alternatively, if the decoder and/or the digitizer are elements of the circuitry or software included in the computer or the associated tablet, then the cable carries the analog output of the photodetector or the pulse signal output of the digitizer.

In the embodiment of Figure 7, the scanning beam is emitted from the rear section of the stylus toward the tip. To ensure proper spacing, the user may place the tip of the stylus in contact with the surface on which the information appears, in which case the body of the stylus serves as a spacer similar to the spacer 421 shown in Figure 4.

For X,Y positional data input, the stylus of Figure 7 would be used in combination with a data input tablet, such as the resistive tablet disclosed in U.S. Patent No. 4,972,496. The stylus includes a conductive contact 46 at the tip to which a source voltage is applied. The stylus may contain a voltage source, such as battery (not shown), or the system may supply the voltage to the stylus 10 from an external source such as the system power supply via the cable connection to the tablet. The tablet includes an input screen for determining an X,Y position on an electrically resistive plate. To input data, the operator touches the tip 46 of the stylus to the input screen. This applies the voltage from the tip to the screen at the touched position. The touched position is charged by the stylus with a positive voltage with respect to a plurality of plate measurement points, typically at corners of the screen. The voltages at these plate measurement points vary as a function of the distance from the plate measurement points to the actual touch position of the pen. These voltages are sequentially measured in the X and Y directions by using conventional means, such as an interface/multiplexer. After analog-to-digital conversion of the detected voltages, a microcontroller checks to ensure the signal's numerical value is "valid" (e.g., is within the possible range of voltages), and then converts the voltages to X and Y distances.

As discussed above, the stylus embodiment uses resistive contact type electronics such as disclosed in U.S. Patent No. 4,972,496, to provide X,Y data input to a digitizer tablet and display device. Other forms of stylus electronics, however, can be readily adapted to use in the inventive stylus. For example the stylus electronics could rely on a light pen technology, on capacitive contact detection circuitry, pressure sensitive contact detection circuitry, ultrasonic proximity detection circuitry, etc. In each case, the key feature is that the stylus incorporates both the electronics necessary to provide X,Y position data input to an electronic tablet and the scanner and detector and any associated electronics of a optical reader such as a bar code scanner.

Also, in the above embodiment, a cable provides power to the stylus and carries various signals from the stylus to the associated computer system. Alternatively, the stylus may include a battery to supply power and a wireless transmitter. The transmitter could be a radio transmitter, an infrared transmitter, an ultrasonic transmitter or any other type wireless transmitter. The transmitter sends analog or digital signals resulting from the scan of the optically encoded information to the associated computer system.

The stylus of Figure 7 directs the scanning beam from the rear section of the stylus toward the tip. In alternate embodiments of the stylus, shown in Figures 8 and 9, the scanner emits a beam in the opposite direction. As shown in Figure 8, the stylus is shaped like a pen with an enlarged distal end. The enlarged distal end of the stylus housing contains a moving beam laser scanner engine 82. The scanner engine could, for example, comprise a scanner motor, a support structure mounted on the motor shaft and a laser and optics subassembly similar to components 20, 26 and 28 discussed above relative to Figure 7, or the scanner engine could comprise any conventional emitter and scanning optics which are small enough to fit into a stylus housing of convenient dimensions.

The enlarged distal end of the stylus housing also contains a photodetector 83, for example a light sensitive photodiode. The scanner engine 82 emits a scanning beam through a window formed in the rear surface of the stylus housing. A portion of the light reflected off the symbol passes along a return path back through the window to the photodetector 83. Detector 83 senses the variable intensity of the returning portion of the reflected laser light over a field of view and generates an electrical analog signal indicative of the detected variable light intensity.

The housing also contains electronics 84 for the optical reader. These electronics will include at least the circuitry necessary to drive the scanning motor, and may include circuitry such as the digitizer and/or decoder for processing the signal from the photodetector. A scan switch 81 mounted

near the fore end portion of the stylus serves as a trigger to activate the scanning engine 82, photodetector 83 and scanner electronics 84. The cable 85 optical carries signals representing the information scanned to the associated computer system. To operate the optical reader, the user holds the fore end portion of the stylus, points the distal end of the stylus at the information to be scanned and presses switch 91.

The fore end portion of the stylus contains the electronics 80 necessary to operate the stylus for X, Y positional data input to a digitizer tablet. The stylus could include a conductive contact at the tip and means to apply a source voltage to the tip, as in Figure 7, or any other form of stylus electronics as mentioned above. In this embodiment, the cable 85 supplies all power to the stylus for operation of both the stylus electronics 80 and the scanning engine 82, photodetector 83 and scanner electronics 84 of the optical reader system.

Figure 9 shows a combination stylus and optical reader similar to that of Figure 8 but using a wireless transmitter to send signals representing scanned information to the associated computer system. The stylus of Figure 9 again is shaped like a pen with an enlarged distal end. The enlarged distal end of the stylus housing contains a moving beam laser scanner engine 92, similar to the engine 82 discussed above. The enlarged distal end of the stylus housing also contains a photodetector 93, for example a light sensitive photodiode. The scanner engine 92 emits a scanning beam through a window formed in the rear surface of the stylus housing. A portion of the light reflected off the symbol passes along a return path back through the window to the photodetector 93. The housing also contains electronics 94 for the optical reader which include at least the circuitry necessary to drive the scanning motor, and may include circuitry such as the digitizer and/or decoder for processing the signal from the photodetector. A scan switch 91 mounted near the fore end portion of the stylus serves as a trigger to activate the scanning engine 92, photodetector 93 and scanner electronics 94. Again, to operate the optical reader, the user holds the fore end portion of the stylus, points the distal end of the stylus at the information to be scanned and presses switch 91.

The fore end portion of the stylus contains the electronics 90 necessary to operate the stylus for X, Y positional data input to a digitizer tablet. The stylus could include a conductive contact at the tip, as in Figure 7, and a battery 92 to apply a source voltage to the tip, or the stylus could contain any other form of stylus electronics as mentioned above.

A wireless transmitter 96 sends analog or digital signals resulting from the scan of the optically encoded information to the associated computer system. The transmitter could be a radio transmitter, an infrared transmitter, an ultrasonic transmitter or any other type wireless transmitter. In this embodiment, the battery 92 supplies all power to the stylus for operation of both the stylus electronics 90 and the scanning engine 92, photodetector 93 and scanner electronics 94 of the optical reader system and power to the wireless transmitter 96.

In a further embodiment, the present invention incorporates the optical scanner, for reading optically encoded indicia, into a mouse type data input device. This embodiment would include a mouse with relatively standard electronics. Figure 10A, for example, shows a track ball 43 and associated movement detection electronics 45. The housing of the mouse also contains a moving spot optical scanner module and associated photodetector.

The housing is adapted for grasping, typically in the palm of a user's hand, for manual movement across a flat surface. When located on the flat surface, the track ball extends through an opening in the bottom surface of the housing. During movement of the mouse across the surface, the track ball 43 engages the surface, and the associated electronics 45 detect the extent of the manual movement of the device across the surface. One or two keys are located in the top of the housing (see Figure 10B). Manual depression of these keys operates switches (not shown) within the mouse housing to provide an operator input. These elements of the embodiment of Figures 10A and 10B provide standard "mouse" type inputs to an associated computer.

As in the stylus of Figure 7, the mouse arrangement of Figure 10A comprises a housing containing a lightweight, high-speed, miniature scanning motor 20 similar to that described in U.S. Patent No. 4,496,831. The motor 20 repetitively drives an output shaft 22 in alternate circumferential directions about an axis along which the shaft extends over arc lengths less than 360° in each direction. U-shaped structure 26 supports a laser emitter and optics assembly 28. As the motor 20 repetitively drives output shaft 22 in alternate circumferential directions, the subassembly 28 and the support structure 26 jointly oscillate and turn with the shaft 22. The subassembly 28 includes an elongated hollow tube 30, a laser diode 32 fixedly mounted at one axial end region of the tube 30, a lens barrel 34 mounted at the opposite axial end region of the tube 30. The lens barrel contains a focusing lens (not shown) such as a plano-convex lens, but may be spherical, convex or cylindrical.

The solid state laser diode 32, of the subassembly 28, generates an incident laser beam, either in the invisible or visible light range. The lens focuses the laser beam which is reflected off of a

mirror 49, and the focused beam passes through the window 40. In this embodiment, the window 40 is formed in the bottom surface of the mouse housing such that the beam cross-section or beam spot will have a certain waist size at distances within a working range relative to the housing. Instead of using the mirror 49, the motor, support and emitter and optics assembly could be positioned to emit light downward through window 40 directly. In either case, during the alternate, repetitive oscillations of the shaft 22, as the support 26 and the subassembly 28 concurrently oscillate, the beam spot sweeps through an arc across the encoded information or bar code symbol positioned a distance below the lower surface of the mouse housing.

The scanner emits a beam of light from the bottom surface of the mouse housing, and the photodetector 44 detects the variable intensity of the returning portion of the reflected light and generates an electrical analog signal indicative of the detected variable light intensity. Typically, at least the digitizer for converting analog signals from the photodetector to a pulse signal would also be located within the housing of the mouse.

The embodiment of Figures 10A and 10B includes a third trigger on the mouse to activate the optical reader components (see plan view of Figure 10B). Typically, the user picks up the mouse, orients it so as to direct the beam along a path toward the information to be scanned, and activates the third trigger switch 42 on the top surface of the housing to activate the moving spot scanner and associated photodetector. When the user has not activated switch 42, the unit operates as a standard computer mouse.

A second version of the mouse includes a contact switch 42' mounted in the lower surface of the housing, as shown in Figure 11. The mouse includes the components of an optical reader engine or module 70 similar to the components 20, 26 and 28 discussed above and includes a standard track ball and position detection electronics similar to 43 and 45. The contact switch detects when the mouse is resting on a surface and controls the device to provide standard mouse type signals to the associated computer. When the operator lifts the mouse off the surface, however, the contact switch triggers operation of the optical reader module 70. The operator then points the mouse so that the beam scans across the optically encoded indicia.

In the mouse embodiments illustrated in the drawings, the mouse connects to the associated computer via a cable (Figures 10B and 11). This cable could connect to a port on the back of the computer or to a port on the keyboard. The cable supplies all necessary power to the movement detection electronics 45 and any circuitry needed to detect button operation, and it supplies all necessary power to the laser diode 32 and motor 20 of the scanner, the photodetector 44 and the associated electronics for processing the signal from the photodetector. As an alternative, the mouse could incorporate a battery and a wireless transmitter similar to the transmitter 96 in the embodiment of Figure 9. The transmitter would send analog or digital signals resulting from the scan of the optically encoded information to the associated computer system and the signals relating to the mouse movement and button operation. The battery would supply all power to the mouse for operation of both the mouse type electronics and the optical scanning, detection and signal processing electronics for optical reading of indicia.

Typically, the light beam emitted by the scanners of the present invention will be in the visible range of the spectrum, for example red light. Consequently, the beam scan across the code or indicia will be visible to the operator. The decode logic may reside within the same housing as the scanner, for example in the integrated terminal embodiment, or the decode logic may be software resident in the associated computer system. The decode logic can provide a "beep" signal as an audible output upon detection of a valid read result. The visible beam and the "beep" signal provide feedback to the operator as to the operation of the scanner.

Although the integrated terminals of Figures 5-11 have been described as using a moving spot scanner, it would be a simple matter to substitute a fixed beam emitter. For example, a fixed laser emitter and optics, such as shown in the wand of Figure 1A, might replace the components for producing the scanning laser.

The invention may be summarized as providing

a device for reading optically encoded information comprising:

means for producing a beam of light for direction toward optically encoded information;

a photodetector for sensing light reflected back from the optically encoded information.

The invention may be summarized as providing

an electronic stylus for use with a computer having a digitizer, said stylus comprising:

a light emitter for emitting light for illumination of optically encoded information.

Preferred embodiments of the invention are disclosed in the claims and also the dependent claims, which should be read as depending not only on the specified claims, but on any other claim and combination thereof. The same is true for the following summary of the invention:

The invention may be summarized as follows:

1. A device for reading optically encoded information comprising:

means for producing a diverging beam of light for direction toward optically encoded information;

a photodetector for sensing light reflected back from the optically encoded information; and

means, coupled to the means for producing a diverging beam of light, for contacting a surface on which the optically encoded information is formed to selectively define at least two different distances between the means for producing a diverging beam of light and the optically encoded information, whereby the diameter of the diverging beam of light at its point of impact on the optically encoded information will be different for each of the two different distances.

2. A device for reading optically encoded information as in 1, wherein the means for producing a diverging beam of light include a laser.

3. A device for reading optically encoded information as in 2, wherein the means for producing a diverging beam of light include an optical element for focusing light emitted by the laser to a focal point, and the means for contacting a surface selectively define the at least two different distances between the focal point and the optically encoded information.

4. A device for reading optically encoded information as in 1, wherein the means for producing a diverging beam of light produce a moving spot beam for optical scanning across the encoded information.

5. A device for reading optically encoded information as in 1, wherein the means for contacting a surface to selectively define at least two different distances comprise:

a housing fixedly supporting the means for producing a diverging beam of light so that the beam of light emerges from one end of the housing; and

a spacer.

6. A device for reading optically encoded information as in 5, wherein the spacer is detachable from the one end of the housing such that the one end of the housing without the spacer defines a first one of the distances and the housing with the spacer mounted on the one end thereof defines a second one of the distances.

7. A device for reading optically encoded information as in 5, wherein the spacer slideably mounts on the one end of the housing.

8. A device for reading optically encoded information as in 5, wherein the spacer threadable mounts on the one end of the housing.

9. A method of reading optically encoded information comprising:

producing a diverging beam of light;

contacting a surface on which the optically encoded information is formed to define a first distance between a focal point of the diverging beam of light and the optically encoded information;

directing the beam of light toward optically encoded information;

sensing light reflected back from the optically encoded information;

contacting a surface on which the optically encoded information is formed to define a second distance between the focal point of the diverging beam of light and the optically encoded information, wherein said second distance is different from said first distance;

directing the beam of light toward the optically encoded information; and

sensing light reflected back from the optically encoded information.

10. A method of reading optically encoded information of different densities comprising:

producing a diverging beam of light;

contacting a surface on which optically encoded information of a first density is formed to define a first distance between a focal point of the diverging beam of light and the optically encoded information;

directing the beam of light toward optically encoded information of the first density;

sensing light reflected back and deriving therefrom an electrical representation of the optically encoded information of the first density;

contacting a surface on which optically encoded information of a second density is formed to define a second distance between the focal point of the diverging beam of light and the optically encoded information, wherein said second density is different from said first density and said second distance is different from said first distance;

directing the beam of light toward the optically encoded information of the second density; and

sensing light reflected back and deriving therefrom an electrical representation of the optically encoded information of the second density.

11. A data input and display device comprising:

(a) a housing having an elongated body portion including a front region, a rear region, and an intermediate body region extending between the front and rear regions;

(b) means for generating a light beam directed along a light path toward indicia to be

read, wherein said indicia have parts of different light reflectivity;

(c) means for receiving reflected light from the indicia to produce electrical signals representative of the indicia;

(d) a keyboard disposed on the rear region of the housing out of the light path for enabling manual data entry without manually blocking the light beam; and

(e) a touch sensitive display disposed on the front region of the housing for displaying information oriented so that an upper surface of the touch sensitive display is parallel to said light path.

12. A device as recited in 11, wherein the keyboard has a plurality of manually depressible keys all mounted in the rear region of the housing out of the light path to enable key depression even during reading without manually blocking the light beam.

13. A device as recited in 11, wherein the touch sensitive display comprises a touch sensitive liquid crystal display panel.

14. A data input and display device comprising:

(a) a substantially flat housing having a front surface and a rear surface;

(b) means for emitting a light beam from the rear surface of the housing for direction toward indicia to be read, wherein said indicia have parts of different light reflectivity;

(c) means for receiving reflected light from the indicia to produce electrical signals representative of the indicia; and

(d) a touch sensitive display disposed on the front surface of the housing.

15. A device as recited in 14, wherein the touch sensitive display comprises a touch sensitive liquid crystal display panel.

16. A device as recited in 14, further comprising:

means for sensing two different positional orientations of the scanning head;

means, responsive to detection of one of the positional orientations, for interpreting touches the touch sensitive display as operator inputs; and

means, responsive to detection of one of the positional orientations, for responding to a touch of the touch sensitive display by activating the indicia-detection means.

17. An electronic stylus for use with a computer having a digitizer, said stylus comprising:

a light emitter for emitting light for illumination of optically encoded information;

a photodetector for sensing light reflected from the illuminated optically encoded information and producing an electrical signal representative of the optically encoded information;

stylus electronics for providing positional input data by contacting the digitizer tablet with said stylus; and

a stylus housing containing said light emitter, said photodetector and said stylus electronics, said stylus housing having a tip adapted for contact with the digitizer tablet.

18. An apparatus as in 17, further comprising a wireless transmitter for sending data signals representative of the optically encoded information from said apparatus to a computer.

19. An apparatus as in 17, further comprising an elongated housing having a fore end portion which tapers to a point for contact with a digitizer tablet during operation of the apparatus as a stylus.

20. An apparatus as in 19, wherein a distal end of said housing contains the light emitter and the photodetector, said light emitter being oriented to emit the light in a direction toward the point of the fore end portion of the housing.

21. An apparatus as in 19, wherein a distal end of said housing contains the light emitter and the photodetector, said light emitter being oriented to emit the light in a direction away from the point of the fore end portion of the housing.

22. An apparatus comprising:

a housing adapted for manual movement across a surface;

means for engaging the surface and detecting the manual movement of the housing across the surface, said means for engaging being mounted in the housing and extending from a bottom surface of the housing;

a light emitter for emitting light through the bottom surface of the housing;

optical scanning means for automatically causing the light from the emitter to scan across an object surface;

a photodetector for sensing light reflected from the object surface and producing an electrical signal representative of any optically encoded information formed on the object surface.

23. An apparatus as in 21, further comprising a switch for activating the light emitter and optical scanning means.

24. An apparatus as in 22, where the switch is located on an upper surface of the housing to permit manual activation of the switch by an operator.

25. An apparatus as in 22, wherein the switch comprises a contact switch extending from the bottom surface of the housing for detecting whether or not the housing is located on the surface across which the apparatus is manually moved, said contact switch activating the light emitter and optical scanning means when the housing is not located on the surface across which the apparatus is manually moved.

26. A stylus for use with a portable computer comprising a first member including processing means, and a panel having a flat surface and comprising a digitizer-display unit operatively connected to said processing means,

said stylus comprising:

means in connection with said first member for interacting with said digitizer-display unit such that data may be entered on said digitizer-display unit by contacting said stylus with said flat surface and displayed on said digitizer-display unit; and

a symbol detecting means for generating a laser beam directed toward a symbol to be read on a target, and for receiving reflected light from such symbol to produce electrical signals corresponding to the intensity of the reflected light, said electrical signals being transferable to said processing means.

Claims

1. A device for reading optically encoded information comprising:

   means for producing a diverging beam of light for direction toward optically encoded information;

   a photodetector for sensing light reflected back from the optically encoded information; and

   means, coupled to the means for producing a diverging beam of light, for contacting a surface on which the optically encoded information is formed to selectively define at least two different distances between the means for producing a diverging beam of light and the optically encoded information, whereby the diameter of the diverging beam of light at its point of impact on the optically encoded information will be different for each of the two different distances.

2. A device for reading optically encoded information as in claim 1, wherein the means for producing a diverging beam of light include a laser.

3. A device for reading optically encoded information as in claim 2, wherein the means for producing a diverging beam of light include an optical element for focusing light emitted by the laser to a focal point, and the means for contacting a surface selectively define the at least two different distances between the focal point and the optically encoded information.

4. A device for reading optically encoded information as in claim 1, wherein the means for producing a diverging beam of light produce a moving spot beam for optical scanning across the encoded information.

5. A device for reading optically encoded information as in claim 1, wherein the means for contacting a surface to selectively define at least two different distances comprise:

   a housing fixedly supporting the means for producing a diverging beam of light so that the beam of light emerges from one end of the housing; and

   a spacer.

6. A device for reading optically encoded information as in claim 5, wherein the spacer is detachable from the one end of the housing such that the one end of the housing without the spacer defines a first one of the distances and the housing with the spacer mounted on the one end thereof defines a second one of the distances.

7. A device for reading optically encoded information as in claim 5, wherein the spacer slideably mounts on the one end of the housing.

8. A device for reading optically encoded information as in claim 5, wherein the spacer threadable mounts on the one end of the housing.

9. A method of reading optically encoded information comprising:

   producing a diverging beam of light;

   contacting a surface on which the optically encoded information is formed to define a first distance between a focal point of the diverging beam of light and the optically encoded information;

   directing the beam of light toward optically encoded information;

   sensing light reflected back from the optically encoded information;

   contacting a surface on which the optically encoded information is formed to define a second distance between the focal point of the diverging beam of light and the optically encoded information, wherein said second distance is different from said first distance;

   directing the beam of light toward the optically encoded information; and

   sensing light reflected back from the optically encoded information.

10. A method of reading optically encoded information of different densities comprising:

producing a diverging beam of light;

contacting a surface on which optically encoded information of a first density is formed to define a first distance between a focal point of the diverging beam of light and the optically encoded information;

directing the beam of light toward optically encoded information of the first density;

sensing light reflected back and deriving therefrom an electrical representation of the optically encoded information of the first density;

contacting a surface on which optically encoded information of a second density is formed to define a second distance between the focal point of the diverging beam of light and the optically encoded information, wherein said second density is different from said first density and said second distance is different from said first distance;

directing the beam of light toward the optically encoded information of the second density; and

sensing light reflected back and deriving therefrom an electrical representation of the optically encoded information of the second density.

11. A data input and display device comprising:

(a) a housing having an elongated body portion including a front region, a rear region, and an intermediate body region extending between the front and rear regions;

(b) means for generating a light beam directed along a light path toward indicia to be read, wherein said indicia have parts of different light reflectivity;

(c) means for receiving reflected light from the indicia to produce electrical signals representative of the indicia;

(d) a keyboard disposed on the rear region of the housing out of the light path for enabling manual data entry without manually blocking the light beam; and

(e) a touch sensitive display disposed on the front region of the housing for displaying information oriented so that an upper surface of the touch sensitive display is parallel to said light path.

12. A data input and display device comprising:

(a) a substantially flat housing having a front surface and a rear surface;

(b) means for emitting a light beam from the rear surface of the housing for direction toward indicia to be read, wherein said indicia have parts of different light reflectivity;

(c) means for receiving reflected light from the indicia to produce electrical signals representative of the indicia; and

(d) a touch sensitive display disposed on the front surface of the housing.

13. An electronic stylus for use with a computer having a digitizer, said stylus comprising:

a light emitter for emitting light for illumination of optically encoded information;

a photodetector for sensing light reflected from the illuminated optically encoded information and producing an electrical signal representative of the optically encoded information;

stylus electronics for providing positional input data by contacting the digitizer tablet with said stylus; and

a stylus housing containing said light emitter, said photodetector and said stylus electronics, said stylus housing having a tip adapted for contact with the digitizer tablet.

14. An apparatus comprising:

a housing adapted for manual movement across a surface;

means for engaging the surface and detecting the manual movement of the housing across the surface, said means for engaging being mounted in the housing and extending from a bottom surface of the housing;

a light emitter for emitting light through the bottom surface of the housing;

optical scanning means for automatically causing the light from the emitter to scan across an object surface;

a photodetector for sensing light reflected from the object surface and producing an electrical signal representative of any optically encoded information formed on the object surface.

15. A stylus for use with a portable computer comprising a first member including processing means, and a panel having a flat surface and comprising a digitizer-display unit operatively connected to said processing means,

said stylus comprising:

means in connection with said first member for interacting with said digitizer-display unit such that data may be entered on said digitizer-display unit by contacting said stylus with said flat surface and displayed on said digitizer-display unit; and

a symbol detecting means for generating a laser beam directed toward a symbol to be read on a target, and for receiving reflected light from such symbol to produce electrical signals corresponding to the intensity of the

reflected light, said electrical signals being transferable to said processing means.

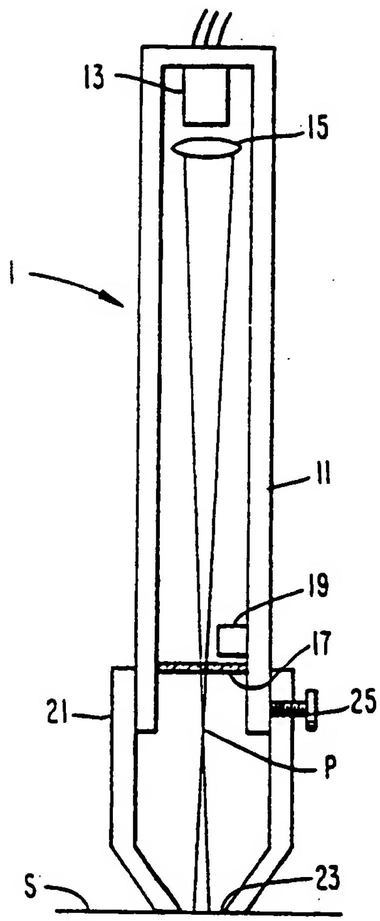

FIGURE 1A

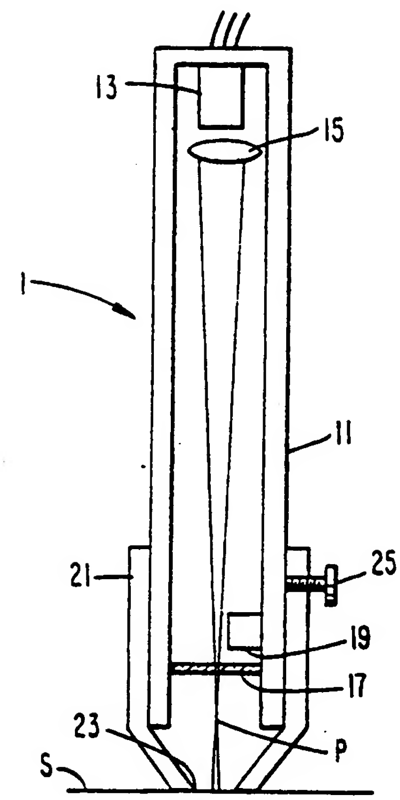

FIGURE 1B

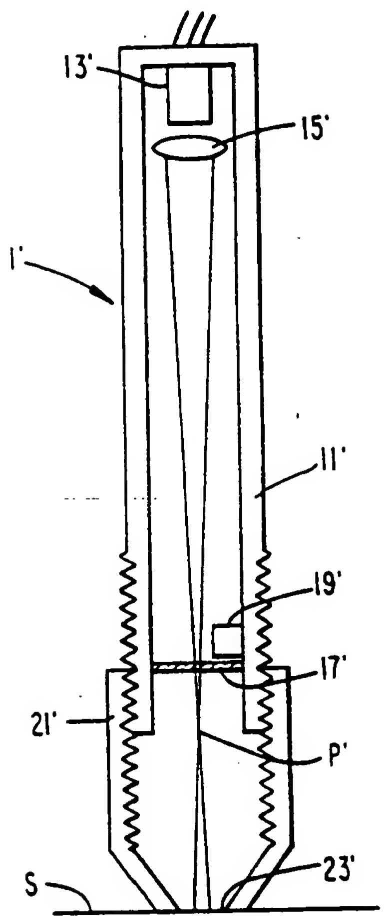

FIGURE 2A

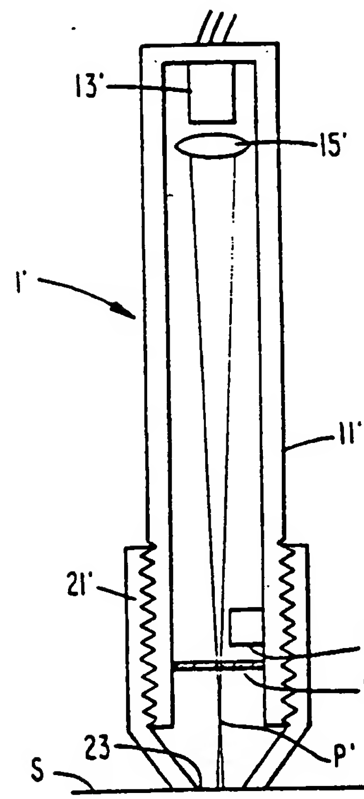

FIGURE 2B

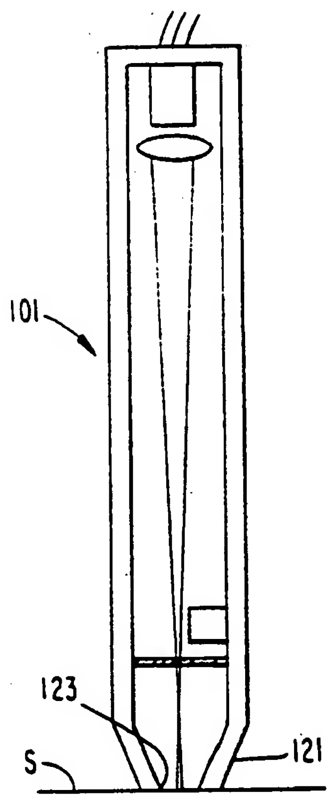

FIGURE 3A

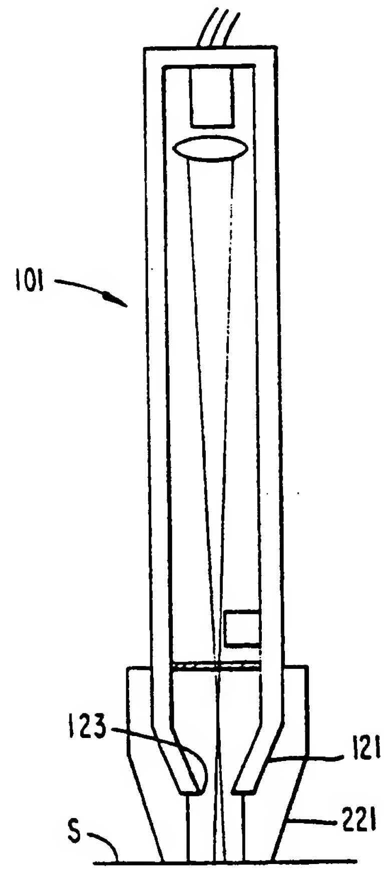

FIGURE 3B

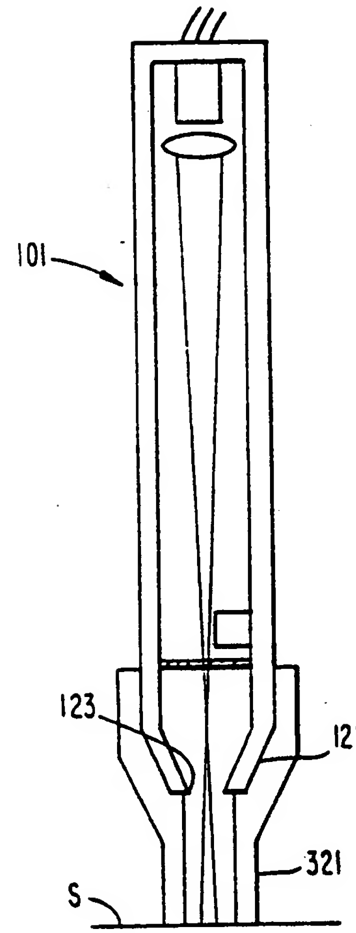

FIGURE 3C

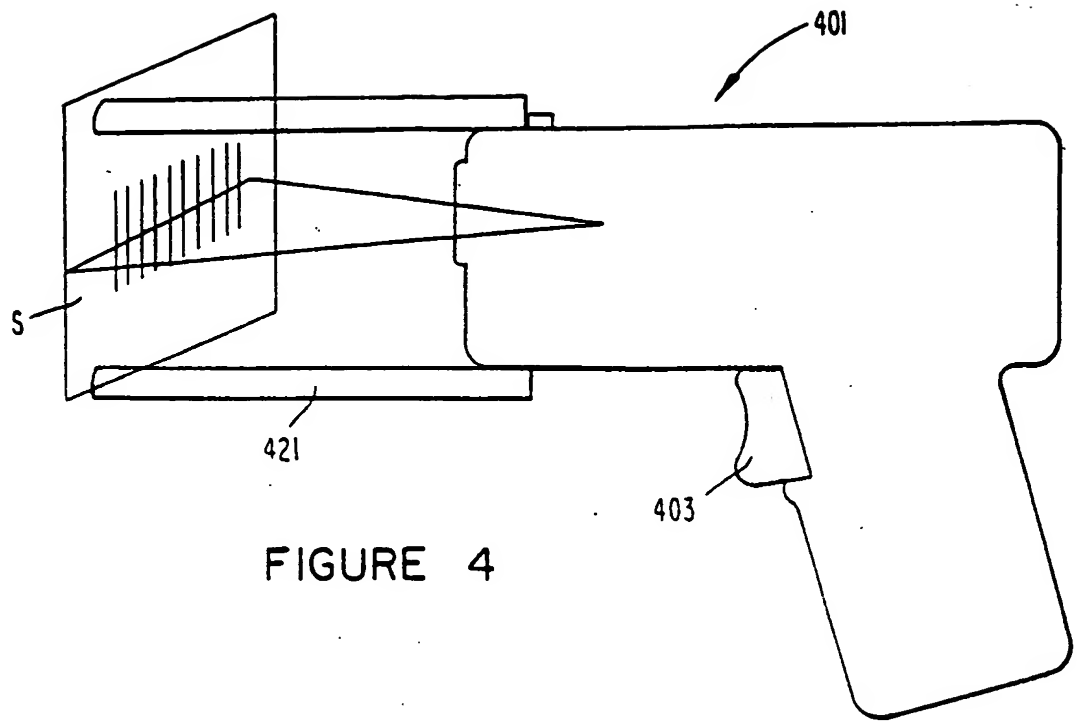

FIGURE 4

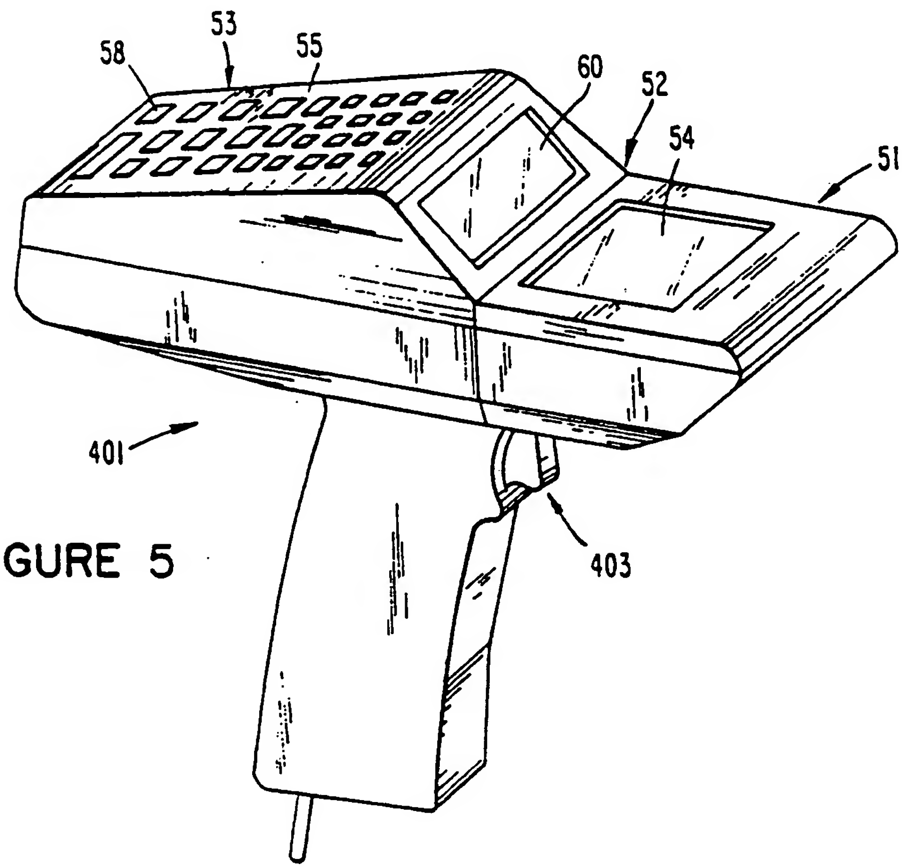

FIGURE 5

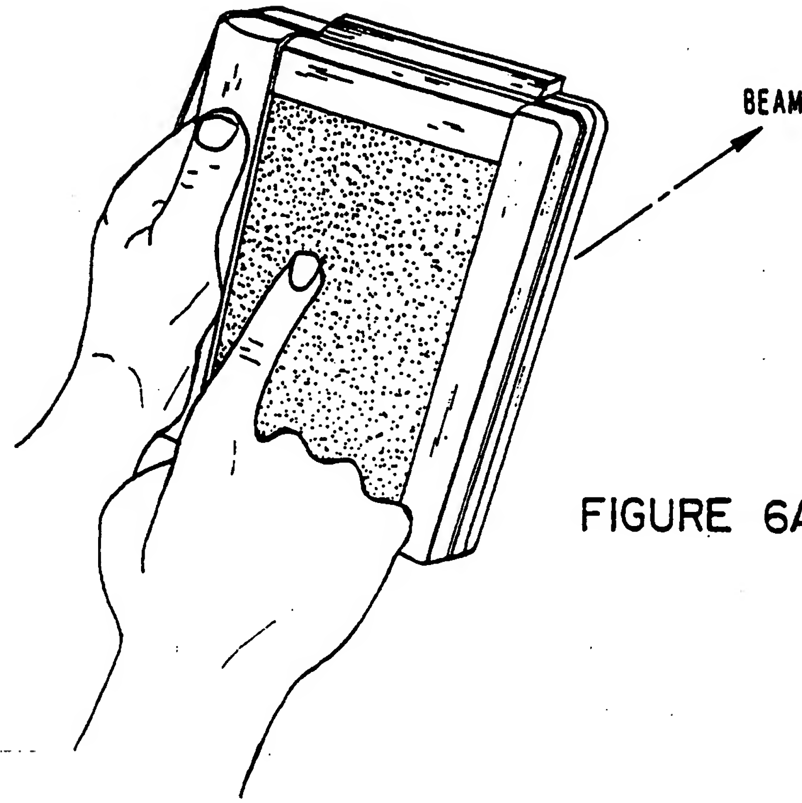

FIGURE 6A

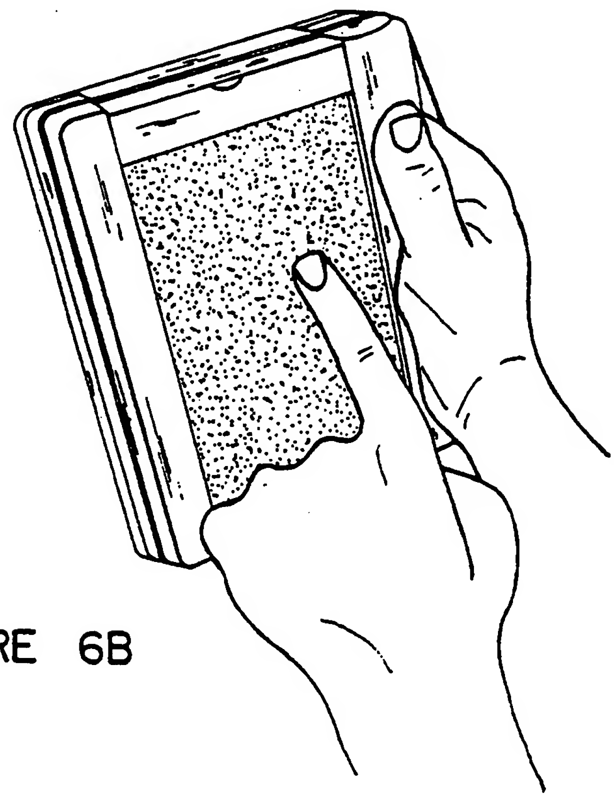

FIGURE 6B

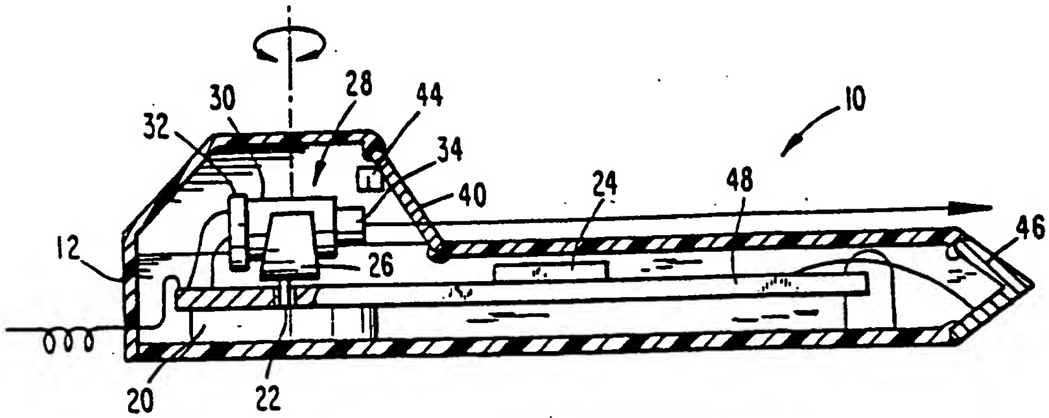

FIGURE 7

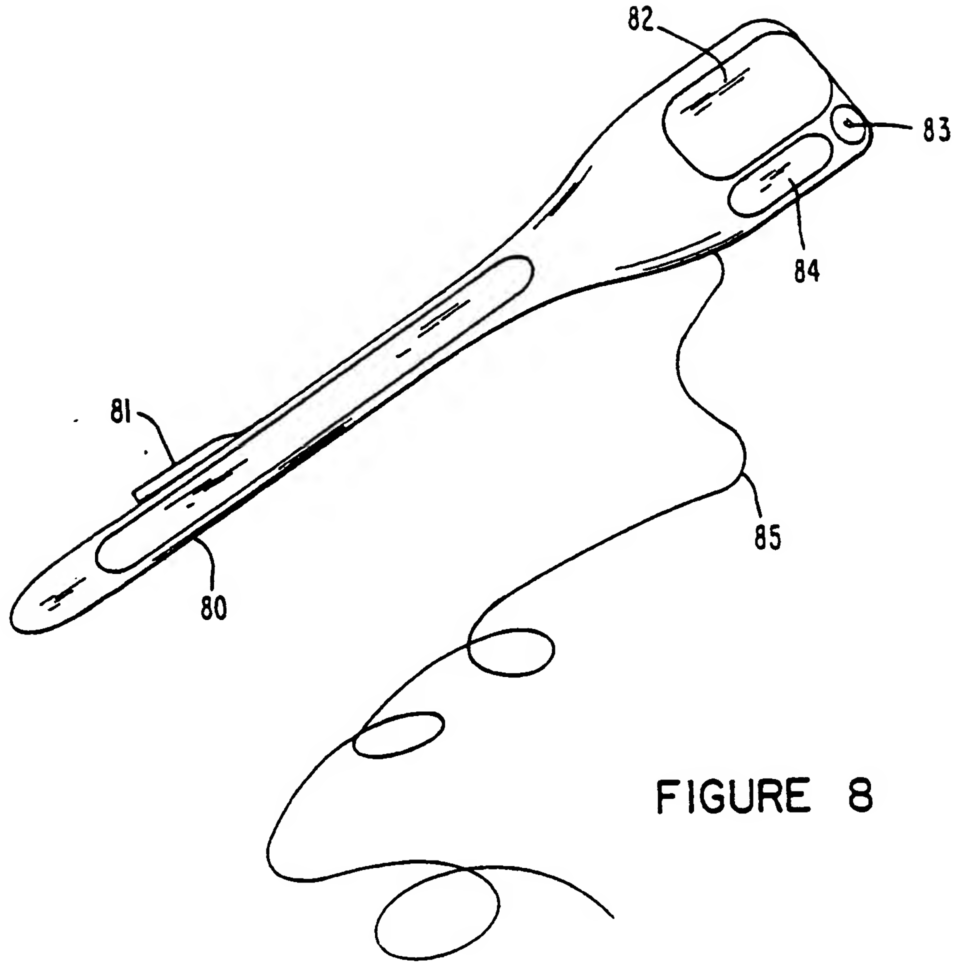

FIGURE 8

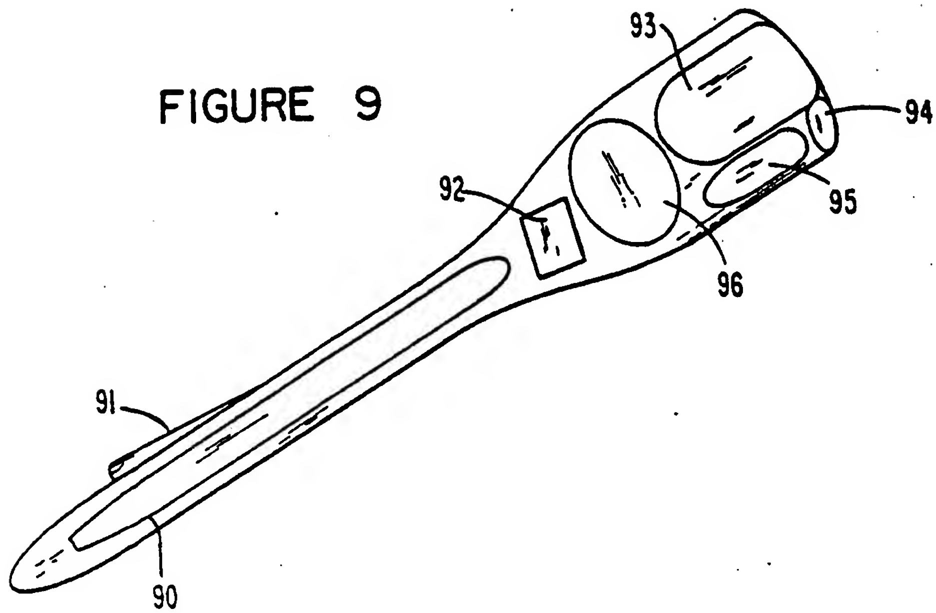

FIGURE 9

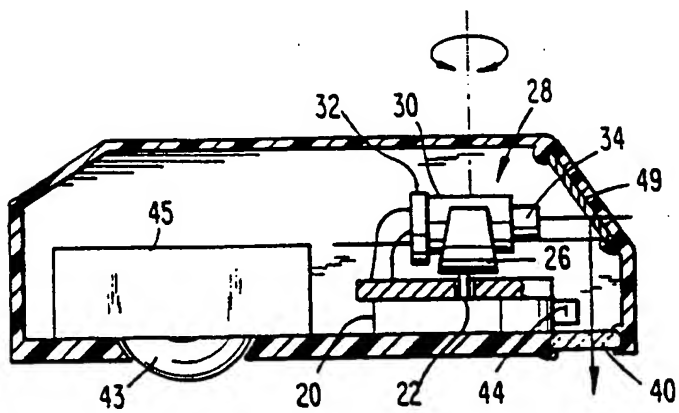

FIGURE 10A

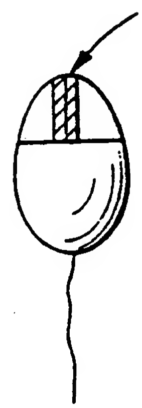

FIGURE 10B

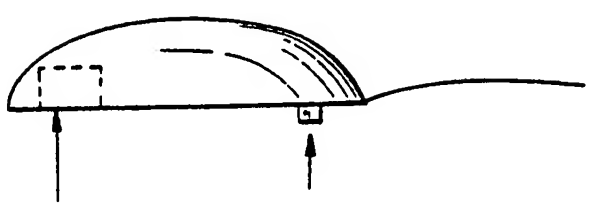

FIGURE 11

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(54) Optical readers.

(57) To read optically encoded information over a wide range of densities, the present invention provides a spacer system (21) on the tip of an optical reader (1). The optical reader (1) may be a contact wand type device, for example including a fixed laser emitter (13). Alternatively, the optical reader (1) may be a moving spot scanner. In either case, the emitter element (13) of the optical reader produces a diverging beam of light. During a reading operation, the spacer contacts the object surface (5) on which optically encoded indicia is formed. The spacer (21) selectively defines at least two different distances between the light emitter (13), or the focal point (P) of the emitted beam of light, and the object surface. Because of the beam divergence, the diameter of the beam at its point of impact on the object surface (5) will be different for each of the two different distances. The different beam diameters provide the optical reader (1) with different effective sensing spots for reading different density symbols. The present invention also incorporates an optical reader, typically a moving spot laser scanner, into a number of different types of computer data input devices, such as the stylus of a digitizer table and a computer "mouse." In one such integrated terminal embodiment, the optical reader is combined with a touch sensitive display and data input device.

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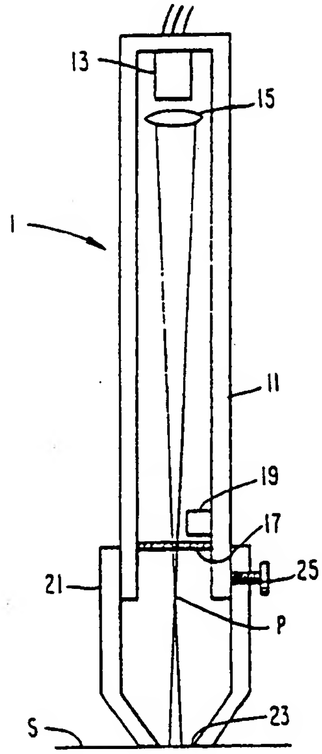

FIGURE 1A

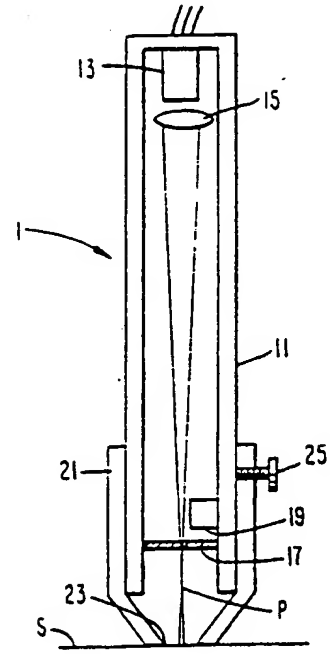

FIGURE 1B

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 10 8880

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X Y	US-A-4 457 016 (PFEFFER) 26 June 1984 * column 4, line 64 - column 5, line 11 * * figure 4 * ---	1,5-10 2-4	G06K7/10
Y	US-A-4 766 297 (MCMILLAN) 23 August 1988 * column 3, line 61 - column 5, line 30 * * figure 1 * ---	2-4	
X	US-A-4 916 441 (GOMBRICH) 10 April 1990 * column 6, line 23 - line 30 * * column 6, line 52 - line 58 * * column 8, line 3 - line 61 * * claims 1,2,7,8 * * figures 2,3,5,6,8 * ---	11,12	
A	US-A-4 698 490 (NAKASE ET AL.) 6 October 1987 * column 2, line 16 - line 56 * * figures 1,2 * ---	1,9,10	
A	US-A-4 679 905 (WESTOVER) 14 July 1987 * column 2, line 61 - column 4, line 24 * * figures 1-3 * -----	1,9,10	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)
G06K

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 March 1994	Goossens, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid,

  namely claims:
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,

namely:

see sheet -B-

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☒ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid,

  namely claims: 1-12
- ☐ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims,

  namely claims:

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,
namely:

1. Claims 1-10: Bar code reader having at least two different reading distances

2. Claims 11,12: Data input and display device having a touch screen

3. Claims 13,15: Electronic stylus for use with a digitizer unit

4. Claim 14 : Optical mouse type input device